

## (12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization International Bureau



(43) International Publication Date  
18 March 2004 (18.03.2004)

PCT

(10) International Publication Number  
**WO 2004/022764 A3**

(51) International Patent Classification<sup>7</sup>: **C12P 13/04, 7/04, 41/00, 12/22, 13/06, C12N 15/53, 9/04**

(21) International Application Number:  
**PCT/EP2003/008631**

(22) International Filing Date: 5 August 2003 (05.08.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
102 40 603.0 3 September 2002 (03.09.2002) DE

(71) Applicant (for all designated States except US): **DEGUSSA AG [DE/DE]; Bennigsenplatz 1, 40474 Düsseldorf (DE).**

(72) Inventors; and

(75) Inventors/Applicants (for US only): **NÁAMNIEH, Shukrallah [IL/DE]; Stippelburggasse 20, 40221 Düsseldorf (DE). HUMMEL, Werner [DE/DE]; Claudiusstrasse 11, 52445 Titz (DE). GRÖGER, Harald [DE/DE]; Akademiestrasse 31, 63450 Hanau (DE).**

(74) Common Representative: **DEGUSSA AG; Intellectual Property Management, PATENTE und MARKEN, Standort Hanau, Postfach 13 45, 63403 Hanau (DE).**

(81) Designated States (national): **AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.**

(84) Designated States (regional): **ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG; ZM; ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).**

## Published:

— with international search report

(88) Date of publication of the international search report:  
21 October 2004

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**WO 2004/022764 A3**

(54) Title: USE OF MALATE DEHYDROGENASE FOR NADH REGENERATION

(57) Abstract: The present invention relates to a process for the preparation of enantiomerically enriched organic compounds. In particular, the present invention relates to an enzymatically operating process, in which, in a coupled enzymatic reaction system, NAD(P)H is consumed by one enzyme for the preparation of the organic compound and the NAD(P)H is simultaneously regenerated by a second enzyme system. A reaction system which operates according to the invention in this manner and an advantageous whole cell catalyst are also proposed.

## INTERNATIONAL SEARCH REPORT

Internal Application No

PCT/EP 03/08631

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C12P13/04	C12P7/04	C12P41/00	C12P13/22	C12P13/06
C12N15/53	C12N9/04			

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C12P C12N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, BIOSIS, WPI Data, PAJ, EMBASE, CHEM ABS Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99 46363 A (ARISTIDOU ARISTOS ; VALTION TEKNILLINEN (FI); RICHARD PETER (FI); T) 16 September 1999 (1999-09-16) examples 6,7,10,12-15,18,24	1-10
X	US 2002/042110 A1 (MITSUHASHI KAZUYA ET AL) 11 April 2002 (2002-04-11) paragraph '0162!	1-10
X	EP 0 385 415 A (MITSUBISHI PETROCHEMICAL CO) 5 September 1990 (1990-09-05) page 10; example 6	1-8 -/-

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

## \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*&\* document member of the same patent family

Date of the actual completion of the international search

12 December 2003

Date of mailing of the international search report

18/03/2004

## Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax: (+31-70) 340-3016

## Authorized officer

Lopez Garcia, F

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 03/08631

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE WPI Section Ch, Week 199001 Derwent Publications Ltd., London, GB; Class B05, AN 1990-003179 XP002264717 -& JP 01 285193 A (DAICEL CHEM IND LTD), 16 November 1989 (1989-11-16) page 156 abstract	1-8
X	DATABASE WPI Section Ch, Week 198630 Derwent Publications Ltd., London, GB; Class B05, AN 1986-194622 XP002264718 -& JP 61 128895 A (TAKARA SHUZO CO LTD), 16 June 1986 (1986-06-16) abstract	1-8
X	GU K F ET AL: "PRODUCTION OF ESSENTIAL L-BRANCHED-CHAIN AMINO ACIDS IN BIOREACTORS CONTAINING ARTIFICIAL CELLS IMMOBILIZED MULTIZYME SYSTEMS AND DEXTRAN-NAD" BIOTECHNOLOGY AND BIOENGINEERING, vol. 36, no. 3, 1990, pages 263-269, XP001156578 ISSN: 0006-3592 page 266; figures 2,7	1-8
X	SUYE S: "COENZYME REGENERATION WITH MALIC ENZYME REACTION SYSTEM" RECENT RESEARCH DEVELOPMENTS IN FERMENTATION AND BIOENGINEERING, XX, XX, vol. 1, no. 1, 1998, pages 55-64, XP000982890 figure 5; table 1	1-8
X	BOMMARIUS A S ET AL: "BIOCATALYSIS TO AMINO ACID-BASED CHIRAL PHARMACEUTICAL-EXAMPLES AND PERSPECTIVES" JOURNAL OF MOLECULAR CATALYSIS. B, ENZYMATICS, ELSEVIER, AMSTERDAM, NL, vol. 5, 1998, pages 1-11, XP002929513 ISSN: 1381-1177 figure 5	1-8

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP 03/08631

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
WO 9946363	A	16-09-1999		FI 980551 A AU 756211 B2 AU 2730399 A EP 0981600 A1 WO 9946363 A1 JP 2001525682 T		12-09-1999 09-01-2003 27-09-1999 01-03-2000 16-09-1999 11-12-2001
US 2002042110	A1	11-04-2002		JP 2000236883 A EP 1013758 A2 US 6312933 B1 US 2002127679 A1		05-09-2000 28-06-2000 06-11-2001 12-09-2002
EP 0385415	A	05-09-1990		JP 2227081 A JP 3076581 A DE 69019843 D1 EP 0385415 A1 US 5416012 A US 5336608 A		10-09-1990 02-04-1991 13-07-1995 05-09-1990 16-05-1995 09-08-1994
JP 01285193	A	16-11-1989		NONE		
JP 61128895	A	16-06-1986		NONE		